12. FORCE MAIN ALTERNATIVES

The Belmont Force Main is proposed to convey treated wastewater to augment flows in Fall Creek, Pogues Run and Pleasant Run during dry weather periods. Thirty million gallons per day (30 mgd) will be provided for flow augmentation, including up to 20 mgd to Fall Creek, 5 mgd to Pogues Run and another 5 mgd to Pleasant Run. An additional 30 mgd was requested by the City of Indianapolis Department of Public Works (DPW) for potential water reuse customers.

The *Preliminary Alternatives Memorandum* prepared by G.E.C., Inc. and Black & Veatch in October 2004 identified eight force main routing alternatives. Two alternatives were removed from further consideration: Alternatives 2 and 3. Alternative 2 was eliminated from further consideration because of the expected construction difficulties and operations and maintenance concerns. Alternative 3 included two sub-alternatives: 3A and 3B. These alternatives were to be located on the western side of White River, but were removed from further evaluation because of the difficulty of conveying water to Pogues Run and Pleasant Run.

12.1 FORCE MAIN ALTERNATIVES

The remaining force main alternatives are Alternatives 1, 4A, 4B, 5A, 5B and 6. Each alternative is described in more detail, and the proposed routes are shown in Figures 12.1 through 12.7. In addition, the maps are shown in greater detail in Appendix G – Preliminary Force Main Alignments.

12. FORCE MAIN ALTERNATIVES

INSERT FIGURE 12.1

12. FORCE MAIN ALTERNATIVES

INSERT FIGURE 12.2

12. FORCE MAIN ALTERNATIVES

INSERT FIGURE 12.3

12. FORCE MAIN ALTERNATIVES

INSERT FIGURE 12.4

12. FORCE MAIN ALTERNATIVES

INSERT FIGURE 12.5

12. FORCE MAIN ALTERNATIVES

INSERT FIGURE 12.6

12. FORCE MAIN ALTERNATIVES

Alternative 1 – Fall Creek/White River Alignment

Alternative 1 would begin at the Belmont Advanced Wastewater Treatment (AWT) Plant and follow the White River to its intersection with Fall Creek. The route would then parallel Fall Creek to the northeast and terminate at Keystone Dam. One smaller diameter force main would transport flow to discharge points at Pogues Run and Pleasant Run. This smaller force main would follow Pleasant Run from the White River to Keystone Avenue and continue north along various side streets within the Keystone Avenue/Rural Street Corridor up to East 21st Street where it runs east to the two discharge points on Pogues Run and Pleasant Run. The total pipe length for this option would be 122,750 feet (23.25 miles). This is the longest force main distance of the alternatives being evaluated.

Alternative 4 A– Pleasant Run/Keystone Avenue/Conrail Alignment

Alternative 4A would begin at the Belmont AWT Plant and continue north along the White River to Pleasant Run. The route would continue northeast along Pleasant Run to Keystone Avenue and along various side streets within the Keystone Avenue/Rural Street corridor up to the Keystone Dam. A smaller diameter force main to transport flow to discharge points at Pogues Run and Pleasant Run would begin at East 21st Street and run adjacent to the Conrail right-of-way. Alternative 4A has a total pipe length of 83,308 feet (15.78 miles).

Alternative 4B– Pleasant Run/Keystone Avenue/East 21st Street Alignment

Alternative 4B would begin at the Belmont AWT Plant and continue north along the White River to Pleasant Run. The route would continue northeast along Pleasant Run to Keystone Avenue and along various side streets within the Keystone Avenue/Rural Street corridor up to the Keystone Dam. A smaller diameter force main to transport flow to discharge points at Pogues Run and Pleasant Run would begin at East 21st Street and run east along 21st Street to the two discharge points along Pogues Run

12. FORCE MAIN ALTERNATIVES

and Pleasant Run as shown on Figure 12.2. Alternative 4B is the shortest route of the alternatives under consideration with a total length of 81,497 feet (15.43 miles)

Alternative 5A – Pleasant Run/Monon Trail/Conrail Alignment

Alternative 5A would begin at the Belmont AWT Plant and continue north along the White River to Pleasant Run. The route would continue to the northeast along Pleasant Run to State Avenue. The route would continue north along State Avenue to Michigan Street; then east to Tecumseh Street. After heading north along Tecumseh Street, the route would follow Nowland Avenue to Commerce Avenue and onto East 16th Street. From East 16th Street, the route would head west to the Monon Trail and then north to Fall Creek and Keystone Dam. A smaller diameter force main to transport flow to Pogues Run and Pleasant Run. The smaller diameter force main route would follow Pogues Run up to East 21st Street and on to follow the Conrail right-of-way to the two discharge points along Pogues Run and Pleasant Run.

Monon Trail Typical View

Alternative 5A is 89,155 feet (16.89 miles), and it passes through non-residential areas following Pleasant Run, Pogues Run, and the Monon Trail. A retired section of the Norfolk Southern rail line runs adjacent to the Monon Trail. There has been some consideration of using this route for a light rail system. If the retired rail line is available, placement of Alternative 5A along this route instead of Monon Trail may be preferable. Placing the force main in the rail line right-of-way may be more costly if rehabilitation of the tracks is required. However, it would limit disruption to Monon Trail users during construction.

12. FORCE MAIN ALTERNATIVES

Alternative 5B – Pleasant Run/Monon Trail/East 21st Street Alignment

Alternative 5B is exactly the same route as Alternative 5A except for the smaller diameter force main to provide flow augmentation for Pogues Run and Pleasant Run. The smaller force main would follow Pogues Run up to East 21st Street and continue east along 21st Street to the two discharge points along Pogues Run and Pleasant Run. The total distance for Alternative 5B is 87, 217 feet (16.52 miles).

Alternative 6 – Pogues Run/Monon Trail Alignment

Alternative 6 would begin at the Belmont AWT Plant and continue north along the White River to the Pogues Run outfall. From the outfall, the route would proceed east along the railroad right-of-way to West Street. The route would continue along West Street to South Street and onto to College Street. From College Street, the route would proceed to Bates Street and then to Shelby Street. From Shelby Street, the route would follow Southeastern Avenue in the right-of-way to Cruse Street and onto Market Street. The route would head east along Market Street to Dickson Street, then to New York Street and east to Dorman Street. After Dorman Street, the route would follow Vermont Street to Pogues Run and northeast to Commerce Avenue. From Commerce Avenue, the route would head northwest to East 16th and onto the Monon Trail. Alternative 6 would follow the Monon Trail north to Fall Creek and then to Keystone Dam. An additional smaller diameter force main would follow Pogues Run up to 21st Street and continue east along East 21st Street to allow for flow augmentation of Pogues Run and Pleasant Run. The total distance for this alternative is 90,858 feet (17.2 miles).

Table 12.1 summarizes the pipe lengths for Alternatives 1, 4A, 4B, 5A, 5B, and 6 at various flow rates to meet the flow augmentation and water reuse goals for the project. Portions of the pipe alignments would require a capacity of 50 to 60 mgd to convey the combined augmentation and water reuse flows from the Belmont AWT Plant. Pipes sized for 5 to 10 mgd of flow would be required to transmit

12. FORCE MAIN ALTERNATIVES

flows from the main force main to outfall structures along Pleasant Run and Pogues Run for each of the alternatives. The force main will provide up to 30 mgd of combined flow augmentation for the Pogues Run, Pleasant Run, and the Fall Creek outfall structures.

Table 12.1
Summary of Pipe Lengths for Alternatives

	Length at Flowrate (ft)				
Alternative	**60 MGD (54" Dia.)**	**50 MGD (48" Dia.)**	**10 MGD (24" Dia.)**	**5 MGD (16" Dia.)**	**Total Pipe Length (ft)**
Alternate 1	6,151	58,503	41,771	16,325	122,750
Alternate 4A	45,419	16,607	3,120	18,162	83,308
Alternate 4B	45,419	16,607	3,120	16,351	81,497
Alternate 5A	39,491	21,837	9,727	18,100	89,155
Alternate 5B	39,491	21,837	9,538	16,351	87,217
Alternate 6	43,231	21,745	10,098	15,784	90,858

There were several considerations involved with evaluating the force main alternatives. The evaluation considered a number of criteria including monetary and non-cost factors. Initially, the proposed routes were selected based on providing access to the force main at the three required discharge points with the following criteria:

- Maximization of green space and surface streets to reduce real estate impacts
- Access to Pleasant Run and Pogues Run outfalls in addition to Fall Creek
- Avoidance of residential areas
- Avoidance of major business and commercial districts
- Avoidance of interstates and major highways
- Avoidance of historical areas
- Avoidance of corridors with significant sites of environmental concern

12. FORCE MAIN ALTERNATIVES

- Avoidance of major utilities
- Maximization of green space, parks, and other potential reuse water connections in the routing alternative corridors
- Selection of the most direct route that best meets the above criteria.

Detailed design of the horizontal and vertical alignments of the force main route will be based on the results of surveys, subsurface analysis, and modeling. Table 12.2 shows a comparison of the pipe length in different type areas by the remaining alternatives.

Table 12.2
Comparison of Pipe Lengths by Types of Ground Cover

Type of Construction	Total Pipe Length (ft)	Street or Sidewalk Construction	Greenways Construction	Monon Trail Construction
Alternative 1	122,750	33,033	89,717	NA
Alternative 4A	83,308	30,592	52,716	NA
Alternative 4B	81,457	54,206	27,251	NA
Alternative 5A	89,155	32,851	44,397	11,907
Alternative 5B	87,217	49,013	26,297	11,907
Alternative 6	90,858	50,812	28,139	11,907

Several factors were evaluated based on discussions with the DPW, U.S. Army Corps of Engineers (USACE), and the project stakeholders. The primary discussion items were impacts on traffic, parks and population. Other considerations included:

- Flexibility for water reuse
- Operation and maintenance issues
- Impact on existing infrastructure
- Constructability including requirements for specialized equipment
- Permitting
- Risk of environmental contamination
- Length of force mains

12. FORCE MAIN ALTERNATIVES

- Cost of force mains
- Public concerns

Each alternative has different concerns and considerations. Alternative 6 would be routed through the downtown area, thereby posing more traffic impacts during construction. Alternatives 1, 4A, 4B, 5A, and 5B would eliminate construction in the downtown area and the related traffic impacts, but would require construction in residential areas.

Alternatives 5A, 5B, and 6 would utilize the Monon Trail, which would impact use of the trail for recreation purposes and bicycle commuting during construction. The Monon Trail is also a popular walkway with many trees. This alignment would require the removal and replacement of these trees and other amenities. If the Monon Trail routes are used, additional amenities could be added to further improve this popular area (e.g., landscaping, benches, nest boxes, fish pools, fountains, etc). Some of these amenities could be added more readily if additional right-of-way was purchased along this route. While cost for returning the trail to its current status is considered for these alternatives, additional amenities to improve the trail are not included at this time.

The alternatives with longer routes offer more flexibility for water reuse. Alternative 1 is longer and more costly, but offers easier access of water reuse to potential customers not yet identified. Since Alternatives 4A, 4B, 5A, 5B, and 6 are along a single route with only the single branch to serve Pogues Run and Pleasant Run, longer connection lines would likely be required to supply potential water reuse customers.

The evaluation of operation and maintenance factors for the alternatives considers the total pipe length and ease of access to the force main. Alternative 4B appears to offer the most favorable post-construction access, and Alternative 1 appears to be the most difficult to access. Access along the Monon Trail would be more difficult

12. FORCE MAIN ALTERNATIVES

than along a residential street, but would be easier than the heavily traveled downtown area.

Constructability of the force main alternatives relates to the construction time, specialized equipment required, and level of difficulty. Areas adjacent to waterways may require dewatering during construction, thereby adding time and cost to the project.

12.2 WATER REUSE

There are presently no identified customers for water reuse. However, there could be opportunities with users where potable water is not necessarily needed, such as for irrigation or industrial use. A determination of likely customers' locations and usage requirements (quantity and duration) is expected before the force main is designed. It is expected that irrigators of green spaces, such as parks or golf courses, may be potential users. Industrial users would need to construct a separate water reuse supply system to be able to use this as a partial water supply. There are also indications that there may be some seasonal variability in the water reuse system if irrigation is a major use. A list of the Top 100 water users in Indianapolis Water's service area has been provided by Veolia Water Indianapolis, and is included in Appendix F - Indianapolis Water Top 100 Usage Customers.

12.3 DESIGN CONSIDERATIONS

The design velocity in the force main is a primary consideration that affects the diameter of the pipe as well as operational costs. Pipe sizes and capital costs are reduced as the velocity in the force main increases. However, pumping costs would increase due to greater head losses associated with higher velocities. Table 12.3 shows a comparison of typical pumping costs and preliminary construction costs considering different velocities for Alternatives 1, 4A, 4B, 5A, 5B, and 6. At this phase of the project, it is recommended that 6 feet per second (fps) be used as the design velocity for the force main.

12. FORCE MAIN ALTERNATIVES

Table 12.3
Summary of Construction and Pumping Costs

		<5 FPS	<6 FPS	<7 FPS	<7.5 FPS
Alternate 1	**Units**				
Construction	$	$20,035,048	$16,635,623	$15,712,574	$14,126,558
Pumping Costs	$/Year	$248,820	$504,233	$626,815	$939,574
Alternate 4A	**Units**				
Construction	$	$17,321,020	$14,757,054	$12,932,512	$12,482,297
Pumping Costs	$/Year	$245,693	$378,158	$616,131	$704,913
Alternate 4B	**Units**				
Construction	$	$17,226,015	$14,674,327	$12,862,898	$12,412,682
Pumping Costs	$/Year	$243,942	$375,049	$610,203	$698,984
Alternate 5A	**Units**				
Construction	$	$17,564,264	$14,895,388	$13,194,631	$12,602,630
Pumping Costs	$/Year	$243,343	$389,545	$615,175	$731,917
Alternate 5B	**Units**				
Construction	$	$17,454,254	$14,801,419	$13,115,956	$12,523,955
Pumping Costs	$/Year	$241,544	$389,545	$608,681	$731,917
Alternate 6	**Units**				
Construction	$	$18,465,178	$15,661,500	$13,836,510	$13,247,003
Pumping Costs	$/Year	$255,326	$409,319	$645,344	$761,593

Notes: These Construction Costs are considering only the cost of pipe and are provided for comparison purposes only.
Costs are based on the January 2005 price levels (ENR-CCI=7297).

12. FORCE MAIN ALTERNATIVES

12.3.1 Pipe Materials and Specifications

While a more detailed assessment is required, based on experience with similar projects, the preliminary recommendations for pipe materials and general specifications are indicated below.

- Depending on soil type, construction and diameter, either prestressed concrete cylinder pipe (PCCP) or cement mortar-lined ductile iron pipe (DIP) would be recommended. The determined pressure rating should accommodate the maximum working pressure of the force main with a surge allowance of 1.5 times the working pressure
- Isolation valves should be installed at approximately 1000-foot intervals along the force main. Spacing considerations should include pipeline profile and field access for inspection and maintenance
- Air-release valves should be installed at pipeline summits and have the vacuum check feature. Air-release valves should be installed in a manhole and passive odor controls should be considered
- Granular pipe embedment material should be Indiana Department of Transportation (INDOT) Size No. 11 or 12 crushed stone. The pipe should be bedded on crushed stone and rock. Sufficient embedment material should be deposited around the pipe up to the springline after placement
- To avoid obstructions or where long-radius curves are permitted, maximum deflection at joints should not exceed the amount allowed by the pipe manufacturer and, in no instance, more than three degrees
- Minimum cover on top of the piping should be 48 inches

Prior to future design phases, it is recommended that a Phase 1 Environmental Site Assessment be conducted on the force main routes still under consideration. The Phase 1 Environmental Site Assessment included with this report did not include the force main route alternatives.

12. FORCE MAIN ALTERNATIVES

12.4 CONSTRUCTION CONSIDERATIONS

12.4.1 White River Crossing/Interstate Crossings

Each alternative would have a major crossing of the White River where the force main exits the Belmont AWT Effluent Pump Station at the Belmont AWT Plant. At the size and depth anticipated, there are two probable methods of construction: soft ground tunneling and directional drilling. Soft ground tunneling is anticipated to be an important part of the overall project and the costs of the two methods are similar. With soft ground tunneling, a shaft would be drilled on each side of the river with the tunnel running between the two shafts. At the conclusion of the crossing installation, the shafts would be closed. Interstate crossings would need to be considered using similar methods.

12.4.2 Topography

Topography affects the ease of construction, as well as pipeline pressures. Excessively high pressures along the force main alignment, due to changes in topography, should be evaluated during future project development phases to determine that the pressures are acceptable.

12.4.3 Environmental Impacts

The proposed force main alignments will be located mostly along existing roadways, within areas previously disturbed by construction. Where the force main is constructed outside of the right-of-way, these locations will be considered undisturbed lands. The force main should be constructed in accordance with Indiana Department of Environmental Management (IDEM) guidelines. In locations where undisturbed land may be encountered, precautions should be taken to protect adjacent lands, structures of historical significance, and archaeological findings. As required by IDEM, an archaeological survey should be preformed prior to design. Removal of trees should be kept at a minimum along the force main alignment.

12. FORCE MAIN ALTERNATIVES

Additionally, approved measures should be taken during construction to control siltation and erosion.

12.4.4 Property Owners/Easements

Most of the force main alignment alternatives lie within the City of Indianapolis (City) and Marion County roadway right-of-way. However, utilities, right-of-way, mature trees, existing pavement and other obstructions may warrant acquisition of other permanent easements to minimize construction costs. Temporary construction easements will also be required in some locations.

12.4.5 Utility Relocations

Utility owners in the project area were contacted during the study. All routes will encounter utilities in some areas. However, the major water and gas transmission mains, fiber optic cables and steam pipes were avoided in development of the alternatives. It is typically the Contractor's responsibility to perform field measurements and verify the location of all underground utilities prior to construction. For electrical poles, the depth of bury is approximately six to seven feet. Typically, it is requested that at least five feet of clearance be maintained between the edge of an electrical pole and the edge of the excavated trench.

12.5 Operation and Maintenance

Operation and maintenance issues related to the force main and appurtenances is expected to be minimal. Construction allowances will be needed for the White River and interstate crossings. The crossings should be constructed within a casing to protect the pipe, and minimize potential future issues with the sections under the river or interstate. Without the casing, it would be costly to repair or replace this section should pipe failure or damage occur.

12. FORCE MAIN ALTERNATIVES

Valves should be placed at approximately 1000-foot intervals to provide isolation for servicing the force main. Stub-outs with valves should be considered during design to permit connections for future water reuse customers. Generally, the project is planned for areas that will be readily accessible for any future required repairs. Air release valves typically are required at high points and would be required as part of the project.